REMARKS

For convenience in responding to the action, the headings used in the action are used herein.

Claim Rejections - 35 USC § 112

Claims 17 and 19 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite. The position of the Office is that the claims are directed to manufacturing a battery, but a battery is not produced. Additionally, the Office states that although the claims recite, as a first step, preparing a temporary-battery, it is not clear what happens to the temporary battery. The Office states that the method should be recited as a "method of forming cracks in an electrode".

The lithium secondary battery recited in the preamble of claims 17 and 19 is produced in the last step of the method when a polymerizable monomer is added to the electrolyte in the temporary-battery and the monomer is polymerized to form the solid electrolyte and fill cracks formed in the active material layer with the solid electrolyte. When the polymerizable monomer is polymerized, the temporary battery becomes the final battery.

In order to clarify that the lithium secondary battery recited in the preamble of claims 17 and 19 is produced in the last step of

the method, claims 17 and 19 have been amended by adding at the end of the claims --thereby forming the battery--.

Removal of the 35 U.S.C. § 112, second paragraph, rejection is requested.

Double Patenting

Claim 18 is objected to under 37 C.F.R. 1.75 as being a substantial duplicate of claim 1.

The difference between these claims is that claim 1 recites the electrode of the battery as comprising "an active material layer provided on a current collector" whereas claim 18 recites the electrode of the battery as comprising "an active material layer formed on a current collector <u>by deposition</u> of an active material". The recitation in claim 18 of "deposition of an active material layer" on a current collector is believed to be more limiting than the recitation in claim 1 of an active material layer being "provided" on a current collector.

Notwithstanding this difference, claim 18 has been amended to recite the electrode of the battery as comprising "an active material layer formed on a current collector by deposition of <u>a thin film of</u> an active material". (Claim 19, line 11, recites similar terminology). A thin film deposited on a current collector

differs from a layer formed on a current collector, for example, from a slurry.

Removal of the double patenting rejection is requested.

Claim Rejections - 35 USC § 102/103

Claims 1-5, 7-8, 16 and 18 are rejected under 35 U.S.C. 102(b) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as being obvious over Okada (JP 10-247520; hereinafter "Okada"). Claims 1-16 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Fukui et al. (U.S. Patent Publication No. 2005/0244711; hereinafter "Fukui") in combination with Okada.

Applicants note, first, that the rejection of claims 1-16 and 18 over Fukui in combination with Okada is not proper because Fukui is not prior art with respect to the claims of the present application. The earliest effective date of Fukui is its U.S. publication date of November 3, 2005. Although Fukui is based on an international application filed in Japan on June 25, 2003, prior to the U.S. filing date, September 30, 2003, of the present application, Fukui is not effective as a reference as of its international filing date because the international application was not published in English. The international application was published in Japanese as WO 2004/004031 on January 8, 2004.

Therefore, only the rejection of claims 1-5, 7-8, 16 and 18 over Okada is addressed herein.

Regarding the rejection of claims 1-5, 7-8, 16 and 18 over Okada, the Office is relying on a machine translation of Okada. The Office notes that paragraph [0014] of the machine translation describes a "high polymer electrolyte" being provided in a "hole" of an electrode. The Examiner appears to be taking the position that the "cracks" recited in the claims of the present application can be interpreted as reading on the "holes" of the electrode of Okada.

The machine translation of Okada is virtually unintelligible. Therefore, applicants are submitting herewith a translation of pertinent portions (paragraphs [0002], [0003], and [0009]-[0015]) of Okada.

In the present invention, cracks in an active material layer or film, which are formed by occlusion and releasing of lithium, are filled with a solid electrolyte. The solid electrolyte is formed in the solid electrolyte by forming cracks in the active material layer of a temporary battery by charging and discharging the temporary-battery, adding a polymerizable monomer to the electrolyte in the temporary-battery to fill the cracks and

polymerizing the monomer to form the solid electrolyte and fill the cracks with the solid electrolyte. The cracks in the active material layer or film do not inherently exist in the active material layer or film before the occlusion and releasing of lithium.

In Okada, on the other hand, a porous polymer electrolyte is formed in pores (or gaps, or holes) that exist in an active material layer between particles of the active material layer of an electrode prior. Example 1 of Okada indicates that the porous polymer electrolyte is formed in the active material layer prior to assembly of the battery and, thus, prior to occlusion and releasing of lithium.

Cracks formed in an active material layer by occlusion and releasing of lithium and filled with a solid electrolyte are not pores existing between active material particles of an active material layer and having a porous electrolyte formed therein. A "crack" is defined in Merriam-Webster's Unabridged Dictionary as "a narrow break or thin slit (as in or across a surface) sometimes caused by incomplete joining, drying, or setting, by strain or decay, or by a blow or fall not sufficiently violent to cause a complete break : FISSURE." A pore, on the other hand, is defined as

"**a** : a minute opening especially in an animal or plant by which matter passes through a membrane **b** : the cross section of a vessel element or tracheid often including both lumen and wall **c** : GERM PORE" and "**a** : a small interstice (as in stone) admitting absorption or passage of liquid **b** : such interstices indicating density <a mineral's fine *pores*>."

Removal of the 35 U.S.C. § 103(a) rejection of claims 1-5, 7-8, 16 and 18 over Okada is believed to be in order and is respectfully solicited.

The foregoing is believed to be a complete and proper response to the Office Action dated November 17, 2005, and is believed to place this application in condition for allowance. If, however, minor issues remain that can be resolved by means of a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number indicated below.

In the event that this paper is not considered to be timely filed, applicants hereby petition for an appropriate extension of time. The fee for any such extension may be charged to our Deposit Account No. 111833.

In the event any additional fees are required, please also charge our Deposit Account No. 111833.

Respectfully submitted,

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Attachment: Partial translation of Okada (JP 10-247520)

Partial Translation
Okada (JP 10-247520)

[0002]
[Prior Art] The lithium ion secondary batteries that are currently available commercially use lithium cobalt oxide and other transition metal composite oxide active materials in their positive electrodes and graphite and other carbon based active materials in their negative electrodes, and they have a structure where the positive and negative electrodes are opposed to each other through a porous polyethylene or polypropylene separator. Furthermore, a solution where a lithium salt such as $LiPF_6$ or $LiBF_4$ is dissolved in various carbonic esters such as ethylene carbonate, ethyl methyl carbonate, dimethyl carbonate and diethyl carbonate is used as an electrolyte.

[0003] The positive and negative electrodes of lithium ion secondary batteries are produced by applying a kneaded mixture of active material particles, a polymer as a binder and acetylene black or the like when the electron conductivity of the active material is insufficient to a current collector and pressing. The gaps between the active material particles in positive and negative electrodes produced in this manner form pores, and because the electrolyte impregnates these pores, the lithium ion transfer path necessary for the electrode reaction is sufficiently assured, and sufficient battery performance has been obtained.

[0009]
[Problems to be Solved by the Invention] In conventional nonaqueous electrolyte batteries that use organic electrolytes, the electrodes have not been equipped with polymer electrolytes. Therefore, the electrodes did not absorb the electrolytic solution and the electrolytic solution was not diffused uniformly in the electrode as a whole, so when the amount of reserve electrolyte in the battery was low, the electrolyte did not diffuse uniformly throughout the battery, and sufficient battery performance could not be obtained. Therefore, it was necessary to put large amounts of electrolytic solution into [the battery] to obtain sufficient battery performance, and as a result, the electrode and separator pores and the gaps between the electrodes and the separator were all filled with the electrolyte. Therefore, when puncture and other safety tests are conducted, there is no air present to form a cushion for increases in pressure in the vicinity of the electrodes, so there are sudden localized increases in pressure because of vaporization of the electrolyte in that vicinity due to heat generated where there are internal shorts. Reactions that

start exothermic chain reactions occur easily and safety is reduced. Therefore, to improve the safety of the battery, there was a need to limit the utilization rate of the active material, and the capacity of the battery was limited; furthermore, there was the problem of increased costs because various safety elements had to be provided.

[0010] Since the ion diffusion rate in the solid electrolytes in nonaqueous batteries that use conventional solid electrolytes is much slower than that for liquid organic electrolytes, the supply of the lithium ions necessary for the electrode reaction is not sufficient, and there is the problem of not obtaining sufficient battery performance when charging and discharging at high rates or charging and discharging at low temperatures.

[0011] In view of the problems described above, the present invention makes it possible to improve the safety of batteries while maintaining a battery performance like that when liquid organic electrolytes are used, and as a result, it is possible to increase capacity and eliminate safety elements by improving the activity ratio [character error in original, not reproducible in English] of the active material.

[0012]
[Means to Solve the Problems] Therefore, the following invention solves the problems described above.

[0013] [The invention] is characterized by being equipped with a positive electrode and negative electrode or separator holding a volume of electrolytic solution of not less than 30% and not greater than 95% of the pore volume and being provided with at least one of polyvinylidene fluoride, polyacrylonitrile, polyvinyl chloride and copolymers having the various monomers constituting the organic polymers above in their structures.

[0014] [Embodiment of the Invention] The nonaqueous electrolyte battery according to the present invention is provided with a porous polymer electrolyte that swells or becomes damp with the electrolytic solution in the electrode pores or on surface of the electrodes. The porous polymer electrolyte has a swelling property or the property of becoming damp, so even when the amount of solution put into the battery is small, the electrolyte is absorbed and is uniformly diffused over the entire electrode. Therefore,

even when a gaseous part remains in the separator pores or electrode pores because the electrolyte held in the battery is less than the amount of electrolyte sufficient to occupy all of the separator pores and electrode pores, the electrolyte is diffused over the entire electrode, and sufficient battery performance can be obtained. Therefore, when puncture and other safety tests were conducted, there is air present to form a cushion for increases in pressure in the vicinity of the electrodes, so the localized increases in pressure were greatly relaxed even when there was vaporization of the electrolyte in that vicinity due to heat generated where there are internal shorts. It is more difficult for reactions [character error in Japanese not reproducible in English] that start exothermic chain reactions to occur and safety is improved. Therefore, since the safety of the battery has been improved, the utilization of the active material, which was limited, can be improved, so large capacity batteries are possible; furthermore, various safety elements can be eliminated, so the cost can be reduced.

[0015] The difference from conventional solid electrolyte batteries is that the polymer provided for the electrodes has pores that hold gas and a free electrolytic solution in the present invention, so the ions in the free electrolytic solution are rapidly diffused, and sufficient battery performance is obtained.